Physical Environment Supporting Documentation

This document records the input parameters, assumptions and results of the models used in the soils and hydrology effects analysis in the Lower Joseph Creek Restoration Project (LJCRP) Environmental Impact Statement. This document is not intended to stand alone as a comprehensive resource specialist report. Please refer to the Physical Environment sections of the LJCRP Environmental Impact Statement for all discussions regarding the purpose and need, proposed action, existing condition and analysis of effects.

Site Specific Riparian Habitat Conservation Area Thinning Sediment Delivery Potential Analysis

Model Used:

WEPP Hillslope/Watershed Model (Windows Interface, Version – September 17, 2012)
Developed by: USDA – Agriculture Research Service, National Soil Erosion Research Laboratory and Purdue University

Input Parameters:

This model was used to evaluate several sites within the LJCRP analysis area to support internal discussions and discussions with members of the public, the tribes and collaborative groups. Dozens of these scenarios were analyzed across the project area before a generic scenario based approach was adopted to characterize the effects across the range of Category 4 RHCA thinning.

Sumac Creek Site Specific Example:

- Analysis Site: Sumac Creek Field Trip Location
- Unit ID: 117
- Slope: 50% (based on steepest part of 117, measured through a digital elevation model)
- Shape: Concave (based on measured slope profile, validated in the field)
- Weather Parameters: 50 year statistical composite weather stream from the Wallowa weather station
- Soils: Klickson-Larabee (40% Klickson) from 2013 SURRGO (OR-631) This map unit complex characterizes the soils in the portion of Unit 117 in the RHCA.
- Disturbance: 2 year Forest Management - To generate a worst case scenario, I assumed that the erosive effects of timber harvest would persist for up to 2 years. Based on field observations and professional judgment, ground cover is typically restored in less than 6 months.
- The model assumes mechanized timber harvest but the unit would be harvested using a partial suspension skyline system. Mechanized timber harvest would increase the erosive potential for the analysis area compared to skyline harvesting and thus would also help characterize a worst-case scenario.
- The model assumes that there is no harvest buffer.

Results

Most of the erosion occurred at the streambank (Figure 1). The total amount of sediment delivered to the stream over 1 acre in this scenario was modeled at .012 metric tons or approximately 25 pounds (about a 5 gallon bucket). However, as part of the proposed action we are designing 25 foot buffers, in which nearly all of the erosion occurred.

2-Year Simulation	Value	Units
Average Annual Precipitation	17.07	in
Average Annual Runoff	0.30	in
Average Annual Soil Loss	0.012	ton/ac
Average Annual Sediment Yield	0.011	ton/ac

Table 1: Model Outputs for the Sumac Creek Site Example

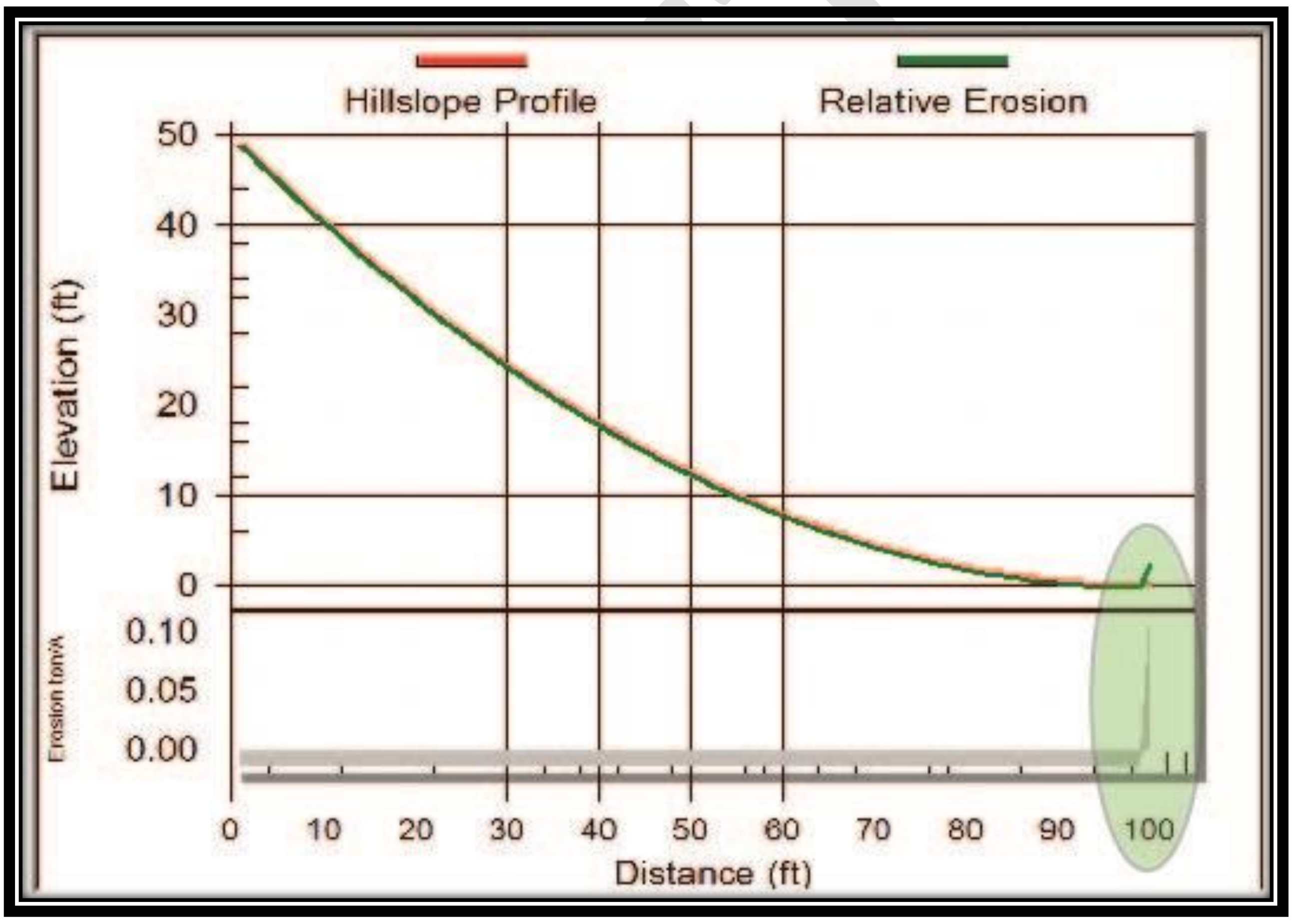

Figure 1: WEPP profile analysis of the Sumac Creek Site Example. The area highlighted in green indicates the point along the profile where the vast majority of the erosion occurred. On the X-axis, 0 indicates the edge of the RHCA and 100 indicates the location of the stream channel.

Conclusion

At the Sumac Creek site, modeling indicated that vegetation management activities in this scenario are unlikely to deliver a significant amount of sediment to the stream channel. It also highlighted the importance of protecting the integrity of the channel. Dozens of sites across the LJCRP analysis area were modeled and produced similar results. However, we felt that a generic scenario based model would better characterize the effects of RHCA harvest for all situations proposed in Alternative 2.

Scenario Based Riparian Habitat Conservation Area Thinning Sediment Delivery Potential Analysis

Model Used:

WEPP Hillslope/Watershed Model (Windows Interface, Version – September 17, 2012)
Developed by: USDA – Agriculture Research Service, National Soil Erosion Research Laboratory and Purdue University

Input Parameters:

This model was used to run a variety of scenarios that evaluated the effects of harvest activities in and adjacent to Riparian Habitat Conservation Areas. This method was developed by Jim Archuleta, Soil Scientist on the Umatilla National Forest, to characterize the effect of slope and soil texture in and adjacent to the RHCA on sediment delivery potential. Additionally, effective ground cover was modeled under harvest scenarios with and without skid trails and wildfire.

Results

WEPP Run Combo	Soil Textures (Loam = L or Silt Loam=SiL)	Upper Element = Harvest Treatment cover (PG = Poor Grass or 40% cover, MF = Mature Forest, or 100% cover ST = Skid Trail, or 10% cover HSF= High Severity Fire or 45% cover	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft.)	Upper Cover (%)	Upper Rock (%)	Lower Element = stream Buffer cover (PG = Poor Grass or 40% cover, MF = Mature Forest, or 100% cover ST = Skid Trail, or 10% cover HSF= High Severity Fire or 45% cover	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft.)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared = if (Delivery Avg (t/ac) <0.03t/ac, True = "Harvest or Trail", False = "No Harvest or No Trail")
Harvest Scenario (Loam Texture)																	
1	L	PG	60	60	1150	40	10	MF	40	5	50	100	10	0.0041	10%	0.0000	Harvest
2	L	PG	60	60	1175	40	10	MF	40	5	25	100	10	0.0371	10%	0.0000	Harvest
3	L	PG	60	60	1195	40	10	MF	40	5	5	100	10	0.1764	10%	0.0044	Harvest
4	L	PG	60	60	1150	40	10	MF	50	5	50	100	10	0.0054	10%	0.0000	Harvest
5	L	PG	60	60	1175	40	10	MF	50	5	25	100	10	0.0453	10%	0.0000	Harvest
6	L	PG	60	60	1195	40	10	MF	50	5	5	100	10	0.1896	10%	0.0089	Harvest
7	L	PG	60	60	1150	40	10	MF	60	5	50	100	10	0.0070	10%	0.0000	Harvest
8	L	PG	60	60	1175	40	10	MF	60	5	25	100	10	0.0546	10%	0.0000	Harvest
9	L	PG	60	60	1195	40	10	MF	60	5	5	100	10	0.2030	10%	0.0089	Harvest
10	L	MF	60	60	1150	100	10	MF	40	5	50	100	10	0.0000	0%	0.0000	Harvest
11	L	MF	60	60	1150	100	10	MF	50	5	50	100	10	0.0000	0%	0.0000	Harvest
12	L	MF	60	60	1150	100	10	MF	60	5	50	100	10	0.0000	0%	0.0000	Harvest
Harvest Scenario (Silt Loam Texture)																	
1	SiL	PG	60	60	1150	40	10	MF	40	5	50	100	10	0.0217	10%	0.0000	Harvest
2	SiL	PG	60	60	1175	40	10	MF	40	5	25	100	10	0.1058	13%	0.0044	Harvest
3	SiL	PG	60	60	1195	40	10	MF	40	5	5	100	10	0.4002	13%	0.0133	Harvest
4	SiL	PG	60	60	1150	40	10	MF	50	5	50	100	10	0.0276	10%	0.0000	Harvest
5	SiL	PG	60	60	1175	40	10	MF	50	5	25	100	10	0.1237	13%	0.0044	Harvest
6	SiL	PG	60	60	1195	40	10	MF	50	5	5	100	10	0.4302	13%	0.0178	Harvest
7	SiL	PG	60	60	1150	40	10	MF	60	5	50	100	10	0.0344	10%	0.0000	Harvest

WEPP Run Combo	Soil Textures (Loam = L or Silt Loam=SiL)	Upper Element = Harvest Treatment cover (PG = Poor Grass or 40% cover, MF = Mature Forest, or 100% cover ST = Skid Trail, or 10% cover HSF= High Severity Fire or 45% cover	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft.)	Upper Cover (%)	Upper Rock (%)	Lower Element = stream Buffer cover (PG = Poor Grass or 40% cover, MF = Mature Forest, or 100% cover ST = Skid Trail, or 10% cover HSF= High Severity Fire or 45% cover	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft.)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared = if (Delivery Avg (t/ac) <0.03t/ac, True = "Harvest or Trail", False = "No Harvest or No Trail")
8	SiL	PG	60	60	1175	40	10	MF	60	5	25	100	10	0.1433	13%	0.0044	Harvest
9	SiL	PG	60	60	1195	40	10	MF	60	5	5	100	10	0.4576	13%	0.0178	Harvest
10	SiL	MF	60	60	1150	100	10	MF	40	5	50	100	10	0.0817	3%	0.0044	Harvest
11	SiL	MF	60	60	1150	100	10	MF	50	5	50	100	10	0.0867	3%	0.0044	Harvest
12	SiL	MF	60	60	1150	100	10	MF	60	5	50	100	10	0.0911	3%	0.0044	Harvest
Skid Trail Scenario (Loam Texture)																	
1	L	ST	35	35	695	10	10	MF	10	5	5	100	10	5.9933	67%	0.6853	No Trail
2	L	ST	35	35	675	10	10	MF	10	5	25	100	10	4.1021	43%	0.2359	No Trail
3	L	ST	35	35	650	10	10	MF	10	5	50	100	10	2.3890	30%	0.0979	No Trail
4	L	ST	35	35	625	10	10	MF	10	5	75	100	10	1.0487	20%	0.0490	No Trail
5	L	ST	35	35	600	10	10	MF	10	5	100	100	10	0.3225	10%	0.0133	Trail
6	L	ST	35	35	695	10	10	MF	20	5	5	100	10	6.3718	67%	0.7877	No Trail
7	L	ST	35	35	675	10	10	MF	20	5	25	100	10	4.8406	43%	0.3204	No Trail
8	L	ST	35	35	650	10	10	MF	20	5	50	100	10	3.3814	33%	0.1602	No Trail
9	L	ST	35	35	625	10	10	MF	20	5	75	100	10	1.8463	20%	0.0757	No Trail
10	L	ST	35	35	600	10	10	MF	20	5	100	100	10	0.6310	13%	0.0267	Trail
11	L	ST	35	35	695	10	10	MF	30	5	5	100	10	6.6234	67%	0.8678	No Trail
12	L	ST	35	35	675	10	10	MF	30	5	25	100	10	5.9022	53%	0.4094	No Trail
13	L	ST	35	35	650	10	10	MF	30	5	50	100	10	3.9053	40%	0.2047	No Trail
14	L	ST	35	35	625	10	10	MF	30	5	75	100	10	2.5804	33%	0.1290	No Trail
15	L	ST	35	35	600	10	10	MF	30	5	100	100	10	1.0186	17%	0.0401	No Trail
16	L	ST	35	35	695	10	10	MF	40	5	5	100	10	6.8552	67%	0.9389	No Trail
17	L	ST	35	35	675	10	10	MF	40	5	25	100	10	6.4480	57%	0.4984	No Trail
18	L	ST	35	35	650	10	10	MF	40	5	50	100	10	4.5536	40%	0.2536	No Trail
19	L	ST	35	35	625	10	10	MF	40	5	75	100	10	3.2448	33%	0.1646	No Trail
20	L	ST	35	35	600	10	10	MF	40	5	100	100	10	1.3901	20%	0.0623	No Trail
21	L	ST	35	35	295	10	10	MF	10	5	5	100	10	2.9056	67%	0.3782	No Trail
22	L	ST	35	35	275	10	10	MF	10	5	25	100	10	1.6852	27%	0.0890	No Trail
23	L	ST	35	35	250	10	10	MF	10	5	50	100	10	0.2535	10%	0.0089	Trail
24	L	ST	35	35	225	10	10	MF	10	5	75	100	10	0.0224	3%	0.0000	Trail
25	L	ST	35	35	200	10	10	MF	10	5	100	100	10	0.0000	0%	0.0000	Trail
26	L	ST	35	35	295	10	10	MF	20	5	5	100	10	3.1205	67%	0.4316	No Trail
27	L	ST	35	35	275	10	10	MF	20	5	25	100	10	2.1688	33%	0.1379	No Trail
28	L	ST	35	35	250	10	10	MF	20	5	50	100	10	0.4160	10%	0.0178	Trail
29	L	ST	35	35	225	10	10	MF	20	5	75	100	10	0.0549	7%	0.0044	Trail
30	L	ST	35	35	200	10	10	MF	20	5	100	100	10	0.0000	0%	0.0000	Trail
31	L	ST	35	35	295	10	10	MF	30	5	5	100	10	3.2224	67%	0.4673	No Trail
32	L	ST	35	35	275	10	10	MF	30	5	25	100	10	2.3890	37%	0.1602	No Trail
33	L	ST	35	35	250	10	10	MF	30	5	50	100	10	0.9046	17%	0.0401	No Trail
34	L	ST	35	35	225	10	10	MF	30	5	75	100	10	0.1411	10%	0.0089	Trail
35	L	ST	35	35	200	10	10	MF	30	5	100	100	10	0.0788	7%	0.0044	Trail
36	L	ST	35	35	295	10	10	MF	40	5	5	100	10	3.3450	67%	0.4895	No Trail
37	L	ST	35	35	275	10	10	MF	40	5	25	100	10	2.5791	37%	0.1869	No Trail
38	L	ST	35	35	250	10	10	MF	40	5	50	100	10	1.1175	17%	0.0490	No Trail
39	L	ST	35	35	225	10	10	MF	40	5	75	100	10	0.1767	10%	0.0133	Trail
40	L	ST	35	35	200	10	10	MF	40	5	100	100	10	0.0899	7%	0.0044	Trail
41	L	MF	35	35	695	100	10	MF	10	5	5	100	10	0.0000	0%	0.0000	Trail
42	L	MF	35	35	695	100	10	MF	20	5	5	100	10	0.0000	0%	0.0000	Trail
43	L	MF	35	35	695	100	10	MF	30	5	5	100	10	0.0000	0%	0.0000	Trail
44	L	MF	35	35	695	100	10	MF	40	5	5	100	10	0.0000	0%	0.0000	Trail
45	L	MF	35	35	695	100	10	MF	50	5	5	100	10	0.0000	0%	0.0000	Trail
46	L	MF	35	35	695	100	10	MF	60	5	5	100	10	0.0000	0%	0.0000	Trail
47	L	MF	35	35	295	100	10	MF	10	5	5	100	10	0.0000	0%	0.0000	Trail
48	L	MF	35	35	295	100	10	MF	20	5	5	100	10	0.0000	0%	0.0000	Trail
49	L	MF	35	35	295	100	10	MF	30	5	5	100	10	0.0000	0%	0.0000	Trail
50	L	MF	35	35	295	100	10	MF	40	5	5	100	10	0.0000	0%	0.0000	Trail
51	L	MF	35	35	295	100	10	MF	50	5	5	100	10	0.0000	0%	0.0000	Trail
52	L	MF	35	35	295	100	10	MF	60	5	5	100	10	0.0000	0%	0.0000	Trail
Skid Trail Scenario (Silt Loam Texture)																	
1	SiL	ST	35	35	695	10	10	MF	10	5	5	100	10	6.3423	33%	0.4717	No Trail
2	SiL	ST	35	35	675	10	10	MF	10	5	25	100	10	3.5352	27%	0.1646	No Trail
3	SiL	ST	35	35	650	10	10	MF	10	5	50	100	10	1.1478	20%	0.0490	No Trail
4	SiL	ST	35	35	625	10	10	MF	10	5	75	100	10	0.5022	13%	0.0223	Trail
5	SiL	ST	35	35	600	10	10	MF	10	5	100	100	10	0.3458	10%	0.0133	Trail
6	SiL	ST	35	35	695	10	10	MF	20	5	5	100	10	6.3423	33%	0.4717	No Trail

WEPP Run Combo	Soil Textures (Loam = L or Silt Loam=SiL)	Upper Element = Harvest Treatment cover (PG = Poor Grass or 40% cover, MF = Mature Forest, or 100% cover ST = Skid Trail, or 10% cover HSF= High Severity Fire or 45% cover	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft.)	Upper Cover (%)	Upper Rock (%)	Lower Element = stream Buffer cover (PG = Poor Grass or 40% cover, MF = Mature Forest, or 100% cover ST = Skid Trail, or 10% cover HSF= High Severity Fire or 45% cover	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft.)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared = if (Delivery Avg (t/ac) <0.03t/ac, True = "Harvest or Trail", False = "No Harvest or No Trail")
7	SiL	ST	35	35	675	10	10	MF	20	5	25	100	10	3.5352	27%	0.1646	No Trail
8	SiL	ST	35	35	650	10	10	MF	20	5	50	100	10	1.1478	20%	0.0490	No Trail
9	SiL	ST	35	35	625	10	10	MF	20	5	75	100	10	0.5022	13%	0.0223	Trail
10	SiL	ST	35	35	600	10	10	MF	20	5	100	100	10	0.3458	10%	0.0133	Trail
11	SiL	ST	35	35	695	10	10	MF	30	5	5	100	10	6.3423	33%	0.4717	No Trail
12	SiL	ST	35	35	675	10	10	MF	30	5	25	100	10	3.5352	27%	0.1646	No Trail
13	SiL	ST	35	35	650	10	10	MF	30	5	50	100	10	1.1478	20%	0.0490	No Trail
14	SiL	ST	35	35	625	10	10	MF	30	5	75	100	10	0.5022	13%	0.0233	Trail
15	SiL	ST	35	35	600	10	10	MF	30	5	100	100	10	0.3458	10%	0.0133	Trail
16	SiL	ST	35	35	695	10	10	MF	40	5	5	100	10	6.3423	33%	0.4717	No Trail
17	SiL	ST	35	35	675	10	10	MF	40	5	25	100	10	3.5352	27%	0.1646	No Trail
18	SiL	ST	35	35	650	10	10	MF	40	5	50	100	10	1.1478	20%	0.0490	No Trail
19	SiL	ST	35	35	625	10	10	MF	40	5	75	100	10	0.5022	13%	0.0223	Trail
20	SiL	ST	35	35	600	10	10	MF	40	5	100	100	10	0.3458	10%	0.0133	Trail
21	SiL	ST	35	35	295	10	10	MF	10	5	5	100	10	3.1809	33%	0.2536	No Trail
22	SiL	ST	35	35	275	10	10	MF	10	5	25	100	10	1.2597	17%	0.0623	No Trail
23	SiL	ST	35	35	250	10	10	MF	10	5	50	100	10	0.2697	7%	0.0089	Trail
24	SiL	ST	35	35	225	10	10	MF	10	5	75	100	10	0.0056	3%	0.0000	Trail
25	SiL	ST	35	35	200	10	10	MF	10	5	100	100	10	0.0000	0%	0.0000	Trail
26	SiL	ST	35	35	295	10	10	MF	20	5	5	100	10	3.4848	33%	0.2982	No Trail
27	SiL	ST	35	35	275	10	10	MF	20	5	25	100	10	1.8914	17%	0.0890	No Trail
28	SiL	ST	35	35	250	10	10	MF	20	5	50	100	10	0.5614	10%	0.0267	Trail
29	SiL	ST	35	35	225	10	10	MF	20	5	75	100	10	0.0104	3%	0.0000	Trail
30	SiL	ST	35	35	200	10	10	MF	20	5	100	100	10	0.0000	0%	0.0000	Trail
31	SiL	ST	35	35	295	10	10	MF	30	5	5	100	10	3.6386	33%	0.3204	No Trail
32	SiL	ST	35	35	275	10	10	MF	30	5	25	100	10	2.2855	17%	0.1157	No Trail
33	SiL	ST	35	35	250	10	10	MF	30	5	50	100	10	0.7929	10%	0.0312	No Trail
34	SiL	ST	35	35	225	10	10	MF	30	5	75	100	10	0.0178	3%	0.0000	Trail
35	SiL	ST	35	35	200	10	10	MF	30	5	100	100	10	0.0000	0%	0.0000	Trail
36	SiL	ST	35	35	295	10	10	MF	40	5	5	100	10	3.7899	33%	0.3427	No Trail
37	SiL	ST	35	35	275	10	10	MF	40	5	25	100	10	2.4883	17%	0.1335	No Trail
38	SiL	ST	35	35	250	10	10	MF	40	5	50	100	10	0.9258	10%	0.0356	No Trail
39	SiL	ST	35	35	225	10	10	MF	40	5	75	100	10	0.0320	3%	0.0000	Trail
40	SiL	ST	35	35	200	10	10	MF	40	5	100	100	10	0.0000	0%	0.0000	Trail
41	SiL	MF	35	35	695	100	10	MF	10	5	5	100	10	0.0025	3%	0.0000	Trail
42	SiL	MF	35	35	695	100	10	MF	20	5	5	100	10	0.0078	3%	0.0000	Trail
43	SiL	MF	35	35	695	100	10	MF	30	5	5	100	10	0.0113	3%	0.0000	Trail
44	SiL	MF	35	35	695	100	10	MF	40	5	5	100	10	0.0163	3%	0.0000	Trail
45	SiL	MF	35	35	695	100	10	MF	50	5	5	100	10	0.0195	3%	0.0000	Trail
46	SiL	MF	35	35	695	100	10	MF	60	5	5	100	10	0.0234	3%	0.0000	Trail
47	SiL	MF	35	35	295	100	10	MF	10	5	5	100	10	0.0000	0%	0.0000	Trail
48	SiL	MF	35	35	295	100	10	MF	20	5	5	100	10	0.0000	0%	0.0000	Trail
49	SiL	MF	35	35	295	100	10	MF	30	5	5	100	10	0.0000	0%	0.0000	Trail
50	SiL	MF	35	35	295	100	10	MF	40	5	5	100	10	0.0001	3%	0.0000	Trail
51	SiL	MF	35	35	295	100	10	MF	50	5	5	100	10	0.0006	3%	0.0000	Trail
52	SiL	MF	35	35	295	100	10	MF	60	5	5	100	10	0.0017	3%	0.0000	Trail

Wildfire Harvest Scenario (Loam Texture)

1	L	PG	60	60	1150	40	10	HSF	40	5	50	100	10	0.3082	23%	0.0133	Harvest
2	L	PG	60	60	1175	40	10	HSF	40	5	25	100	10	0.3086	23%	0.0133	Harvest
3	L	PG	60	60	1195	40	10	HSF	40	5	5	100	10	0.3076	23%	0.0133	Harvest
4	L	PG	60	60	1150	40	10	HSF	50	5	50	100	10	0.3186	23%	0.0133	Harvest
5	L	PG	60	60	1175	40	10	HSF	50	5	25	100	10	0.3178	23%	0.0133	Harvest
6	L	PG	60	60	1195	40	10	HSF	50	5	5	100	10	0.3165	23%	0.0133	Harvest
7	L	PG	60	60	1150	40	10	HSF	60	5	50	100	10	0.3280	23%	0.0133	Harvest
8	L	PG	60	60	1175	40	10	HSF	60	5	25	100	10	0.3261	23%	0.0133	Harvest
9	L	PG	60	60	1195	40	10	HSF	60	5	5	100	10	0.3244	23%	0.0133	Harvest

Wildfire Harvest Scenario (Silt Loam)

1	SiL	PG	60	60	1150	40	10	HSF	40	5	50	45	10	0.1222	10%	0.0040	Harvest
2	SiL	PG	60	60	1175	40	10	HSF	40	5	25	45	10	0.1218	10%	0.0044	Harvest
3	SiL	PG	60	60	1195	40	10	HSF	40	5	5	45	10	0.1219	10%	0.0044	Harvest
4	SiL	PG	60	60	1150	40	10	HSF	50	5	50	45	10	0.1386	10%	0.0044	Harvest
5	SiL	PG	60	60	1175	40	10	HSF	50	5	25	45	10	0.1374	10%	0.0044	Harvest
6	SiL	PG	60	60	1195	40	10	HSF	50	5	5	45	10	0.1366	10%	0.0044	Harvest

WEPP Run Combo	Soil Textures (Loam = L or Silt Loam=SiL)	Upper Element = Harvest Treatment cover (PG = Poor Grass or 40% cover, MF = Mature Forest, or 100% cover ST = Skid Trail, or 10% cover HSF= High Severity Fire or 45% cover	Upper Gradient (%) 1	Upper Gradient (%) 2	Upper Horizontal Length (ft.)	Upper Cover (%)	Upper Rock (%)	Lower Element = stream Buffer cover (PG = Poor Grass or 40% cover, MF = Mature Forest, or 100% cover ST = Skid Trail, or 10% cover HSF= High Severity Fire or 45% cover	Lower Gradient (%) 1	Lower Gradient (%) 2	Lower Horizontal Length (ft.)	Lower Cover (%)	Lower Rock (%)	Delivery (30 years) t/ac	Probability of delivery	Delivery Average t/ac	Activity Cleared = if (Delivery Avg (t/ac) <0.03t/ac, True = "Harvest or Trail", False = "No Harvest or No Trail")
7	SiL	PG	60	60	1150	40	10	HSF	60	5	50	45	10	0.1533	10%	0.0044	Harvest
8	SiL	PG	60	60	1175	40	10	HSF	60	5	25	45	10	0.1512	10%	0.0044	Harvest
9	SiL	PG	60	60	1195	40	10	HSF	60	5	5	45	10	0.1496	10%	0.0044	Harvest
Wildfire Skid Trail Scenario																	
1	L	ST	35	35	695	10	10	HSF	10	5	5	45	10	1.2553	57%	0.1290	No Trail
2	L	ST	35	35	675	10	10	HSF	10	5	25	45	10	1.2280	57%	0.1246	No Trail
3	L	ST	35	35	650	10	10	HSF	10	5	50	45	10	1.1986	53%	0.1202	No Trail
4	L	ST	35	35	625	10	10	HSF	10	5	75	45	10	1.1651	53%	0.1157	No Trail
5	L	ST	35	35	600	10	10	HSF	10	5	100	45	10	1.1144	50%	0.1113	No Trail
6	L	ST	35	35	575	10	10	HSF	20	5	125	45	10	1.0785	43%	0.1024	No Trail
7	L	ST	35	35	550	10	10	HSF	20	5	150	45	10	1.0527	43%	0.0979	No Trail
8	L	ST	35	35	525	10	10	HSF	20	5	175	45	10	1.8710	43%	0.0979	No Trail
9	L	ST	35	35	500	10	10	HSF	20	5	200	45	10	1.1247	40%	0.0979	No Trail
10	L	ST	35	35	475	10	10	HSF	20	5	225	45	10	0.9392	37%	0.0801	No Trail
11	L	ST	35	35	450	10	10	HSF	30	5	250	45	10	0.8771	37%	0.0712	No Trail
12	L	ST	35	35	425	10	10	HSF	30	5	275	45	10	0.8272	33%	0.0668	No Trail
13	L	ST	35	35	400	10	10	HSF	30	5	300	45	10	0.7429	33%	0.0623	No Trail
14	L	ST	35	35	375	10	10	HSF	30	5	325	45	10	0.6304	33%	0.0534	No Trail
15	L	ST	35	35	350	10	10	HSF	30	5	350	45	10	0.5203	30%	0.0490	No Trail
16	L	ST	35	35	325	10	10	HSF	40	5	375	45	10	0.4427	30%	0.0401	No Trail
17	L	ST	35	35	300	10	10	HSF	40	5	400	45	10	0.1700	23%	0.0089	Trail
Wildfire Skid Trail Scenario																	
1	SiL	ST	35	35	695	10	10	HSF	10	5	5	45	10	1.6918	40%	0.1068	No Trail
2	SiL	ST	35	35	675	10	10	HSF	10	5	25	45	10	1.6480	30%	0.1068	No Trail
3	SiL	ST	35	35	650	10	10	HSF	10	5	50	45	10	1.5839	30%	0.1068	No Trail
4	SiL	ST	35	35	625	10	10	HSF	10	5	75	45	10	1.5470	30%	0.0979	No Trail
5	SiL	ST	35	35	600	10	10	HSF	10	5	100	45	10	1.4861	27%	0.0934	No Trail
6	SiL	ST	35	35	575	10	10	HSF	20	5	125	45	10	1.4168	27%	0.0846	No Trail
7	SiL	ST	35	35	550	10	10	HSF	20	5	150	45	10	1.3446	27%	0.0757	No Trail
8	SiL	ST	35	35	525	10	10	HSF	20	5	175	45	10	1.1661	27%	0.0668	No Trail
9	SiL	ST	35	35	500	10	10	HSF	20	5	200	45	10	0.8696	27%	0.0534	No Trail
10	SiL	ST	35	35	475	10	10	HSF	20	5	225	45	10	0.7902	27%	0.0490	No Trail
11	SiL	ST	35	35	450	10	10	HSF	30	5	250	45	10	0.7011	27%	0.0445	No Trail
12	SiL	ST	35	35	425	10	10	HSF	30	5	275	45	10	0.6668	27%	0.0401	No Trail
13	SiL	ST	35	35	400	10	10	HSF	30	5	300	45	10	0.6415	27%	0.3560	No Trail
14	SiL	ST	35	35	375	10	10	HSF	30	5	325	45	10	0.5550	27%	0.0312	No Trail
15	SiL	ST	35	35	350	10	10	HSF	30	5	350	45	10	0.5220	23%	0.0312	No Trail
16	SiL	ST	35	35	325	10	10	HSF	40	5	375	45	10	0.4887	20%	0.0267	Trail

Conclusion

An evaluation of the sediment delivery potentials and probabilities of high volume delivery events (the weather stream captured the 1996-97 50-100 year water event) indicate a very low risk of sediment delivery under harvest only scenarios and harvest and wildfire only scenarios. Sediment delivery increases significantly in scenarios where skid trails were modeled on steep grounds inside the RHCA and adjacent to the RHCA. This information was translated into Project Design Criteria to prevent skid trails from being constructed in any of the high erosion potential scenarios. The direction from this project design extends beyond the RHCA boundaries to protect water resources.

General Road System Sediment Delivery Potential Analysis

Model Used:

Geomorphic Road Assessment and Inventory Package (GRAIP) – GIS interface GRAIP-Lite
Developed by: US Forest Service, Rocky Mountain Research Station

Input Parameters:

This model was used evaluate potential sediment production from forest roads within the LJCRP analysis area. A standard erosion base rate was used that characterizes the basalts of the eastern Oregon. A standard representative vegetation factor developed from the Umatilla River in Eastern Oregon was chosen, as it the most similar to the waterways in the analysis area. All of the roads in this portion of the analysis are system roads, so the maximum road slope of 15% was used. Site specific road information, such road maintenance level and surface type was derived from Forest Service cooperate roads data. This data provides the model information about usage and surface erodability.

Results

This analysis revealed generally very low sediment production for existing roads across the LJCRP analysis area. There are two portions of the project area, along three road systems (4600, 4602 and 4650) that indicate a higher sediment production potential (Figure 2).

Conclusion

Low predicted sediment yeilds within the project area are consistent with personal field observations and spatial analyses of the road system. Most of the roads are constructed on stable landforms with very little slope and a stable substrate. The roads that were identified as having higher potential for sediment delivery will be carefully evaluated for road maintenance and improvmenet opportunities prior to haul. These roads were constructed at slope breaks, mid-slopes and with drainage alignments that increase the potential for sediment delivery if the roads are inadquately maintained or constructed. The entire haul should receive all necessary maintenance to bring them up to standard for haul.

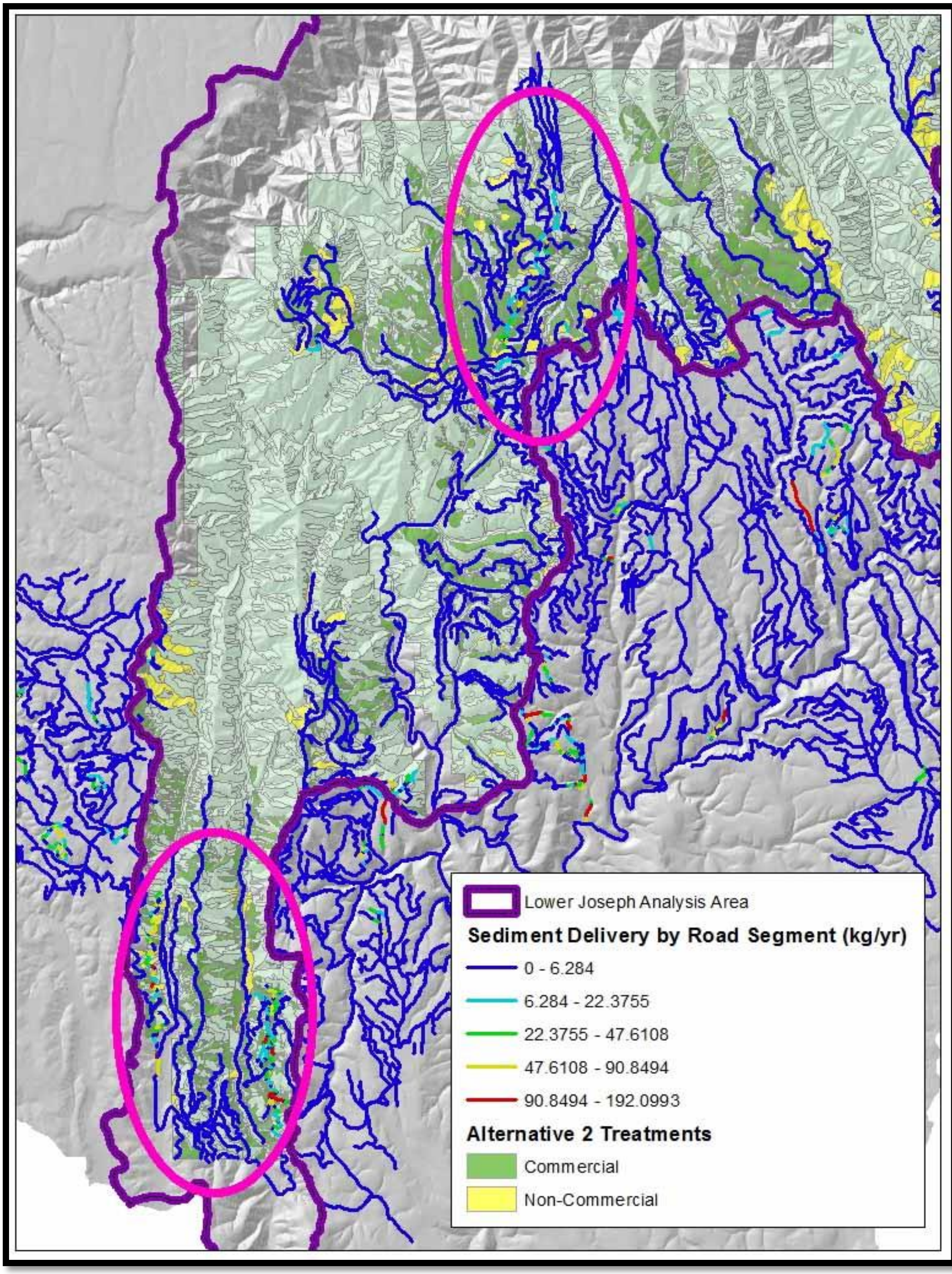

Figure 2: Results from GRAIP analysis indicating sediment delivery potential for the LJCRP road system. Areas highlighed in pink indicate road systems that have a higher potential for sediment delivery.

Haul System Sediment Delivery Potential Analysis

Model Used:

WEPP Roads Model (NETMAP Interface, Version – September 17, 2012)
Developed by: USDA – Agriculture Research Service, National Soil Erosion Research Laboratory and Purdue University

Input Parameters:

To provide a more targeted approach to identify sediment potential from haul activities I chose to use the WEPP Roads model instead of relying solely on GRAIPLite because I can more easily specify changes in traffic to the road system as a result of the proposed activities. After discussions with the Water Resource Specialist with the Nez Perce Tribe, I subset the roads data based on road surface type to more accurately characterize sediment delivery potential. Road maintenance level already takes this into account in the GRAIPLite model but GRAIPLite won't show increases in road use. Therefore a road surface composite WEPP Roads run should be the best way to characterize sediment delivery potential for each road segment during haul. This analysis is based on: outsloped, unrutted roads with a maximum road gradient of 12% because all system roads should be engineered. Three runs were aggregated based on the appropriate road surface information (native, gravel, paved) that was derived from the best available data. A soil type of "sandy loam with 20% rock fragments was selected because it characterizes the more erosive soils on average based on the 2013 soil survey inventories. A 50 year weather stream from Wallowa was used to characterize precipitation events. This weather stream included a 50-100 year high flow event in 1996-97.

Results

This analysis revealed two road systems, FS 4655 and FS portions of FS 4650 that may have a higher potential for sediment production (Figure 3). The GRAIPLite analysis also identified FS 4650 as a potential sediment problem. By subsetting the roads based on surface type, it also revealed that several small segments of low maintenance level roads may be at risk for increased sediment production during haul.

Conclusion

This analysis will inform road maintenance evaluations and work priorities prior to log haul so that we may minimize the amount of sediment delivered to streams from haul system roads during to implementation. It also stresses the importance of adequate road maintenance on low maintenance roads prior to haul. Sediment produced from the haul system, as modeled, would not likely have measurable affects at the watershed scale or even at the subwatershed scale. However, it is important to identify persistent sources of road sedimentation and do our best to mitigate those sources. Any increases in road sedimentation are unlikely to persist much beyond implementation. By improving the conditions of the road system and stream crossings for haul, overall sediment yield from the road system may likely decrease over the long term.

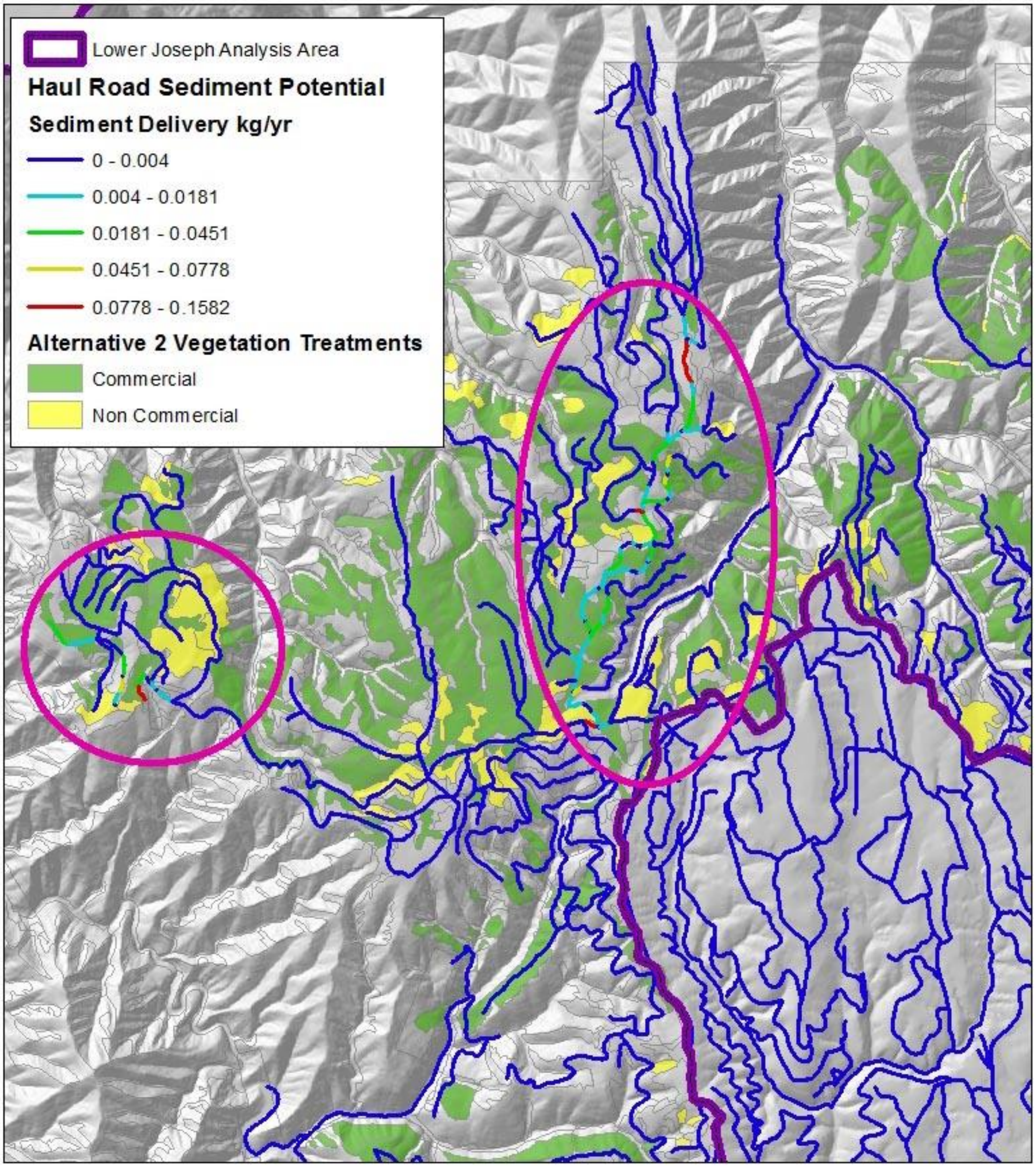

Figure 3: Potential sediment production from haul road system, highlighting FS 4650 and 4655 as having a higher sedimentation potential. Smaller lower maintenance level roads distributed across the whole project area also showed higher potential for sediment production

Temporary Road Sediment Delivery Potential Analysis

Model Used:

WEPP Hillslope/Watershed Model (NETMAP Interface, Version – September 17, 2012)
Developed by: USDA – Agriculture Research Service, National Soil Erosion Research Laboratory and Purdue University

Input Parameters:

The WEPP Roads model was chosen to help approximate the locations of temporary roads, inform Project Design Criteria that will guide any adjustments in their placement and to describe potential effects that pertain to sediment delivery. This analysis is based on: outsloped, unrutted roads with a maximum road gradient of 20% because temporary roads aren't as generally engineered as permanent system roads. Though some temporary roads are designed on existing non-system footprints with an aggregate substrate, to characterize a worse-case scenario, I assumed a native substrate for all temporary roads. A soil type of "sandy loam with 20% rock fragments was selected because it characterizes the more erosive soils on average based on the 2013 soil survey inventories. A 50 year weather stream from Wallowa was used to characterize precipitation events. This weather stream included a 50-100 year high flow event in 1996-97.

Results

This analysis revealed very low sediment production potential for most of the temporary road locations approximated in this analysis. This is largely due to temporary road placement in low gradient landscape positions and with desirable (poor) drainage alignment. Other factors that don't contribute to sediment delivery but were considered as part of temporary road design include wildlife habitat, invasive weeds, sensitive plants, sensitive soils and proximity to fish habitat. Three temporary roads were identified in the analysis as having a moderate to high potential for sediment delivery (Figure 4). This was due to improper drainage alignment and stream crossings. There are four stream crossings designed in four category 4 (intermittent) streams.

Conclusion

It's important to note that temporary road locations are only approximated in this analysis. Project Design Criteria and careful evaluation on the ground will guide their placement. Project Design Criteria will guide the implementing workforce to place temporary roads in the approximate locations identified in this analysis while meeting the intent of the specified design criteria. In the case of sediment delivery, temporary roads should not be designed in alignment with any drainage. Stream crossings should be designed at the lowest possible gradient, when the ground and channel are dry. The crossing should be used and remediated prior to the end of the dry season. Any area that is disturbed within 25 feet of the channel should have weed free mulch applied to it to mitigate erosion. In the areas identified for potential stream crossings, the implementing unit should evaluate alternatives for management that do not necessitate stream crossings providing the options are consistent with all other temporary road design criteria (See Appendix K).

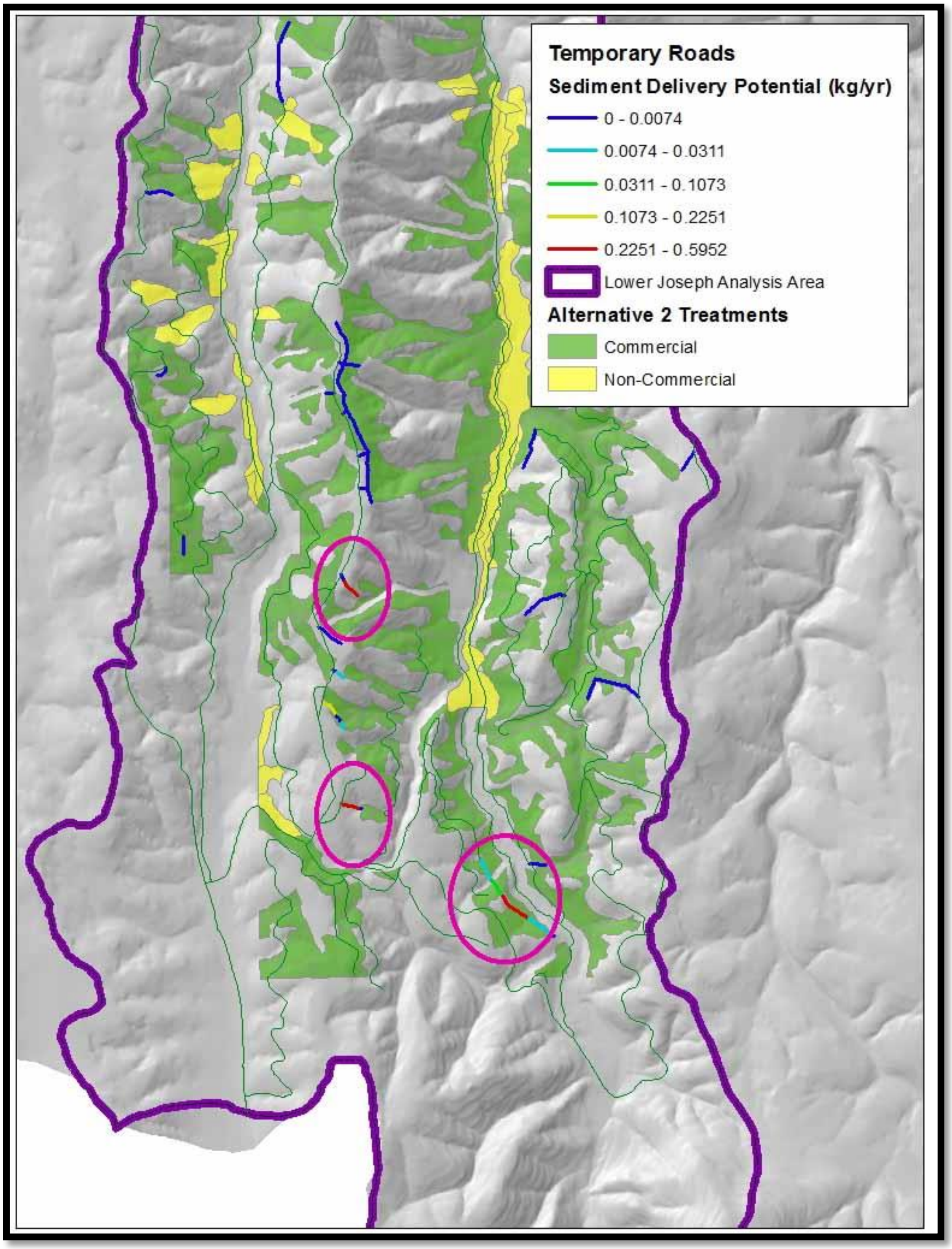

Figure 4: Results from WEPP Roads analysis indicating sediment delivery potential for the LJCRP temporary road system. Areas highlighed in pink indicate temporary roads that have a higher potential for sediment delivery. These locations are approximate and sediment related issues will be largely mitigated through Project Design Criteria.

Flood Plain Delineation Analysis

Model Used:

NETMAP Floodplain Mapping Tool

Input Parameters:

The NETMAP Floodplain Mapping Tool uses a 10 meter resolution Digital Elevation Model (DEM) and computes areas that would be inundated based on specified parameters of bankfull maximum multipliers or height above channel. Based on field observations and evaluation of channel morphology in the DEM, I selected a three times the bankfull maximum as the multiplier to characterize the floodplains.

Results

After evaluating several other user controlled variables I was most satisfied with the 3xbankfull to characterize floodplains. Generally, it overestimates the size of the floodplains but I found that if I used anything smaller, portions of other stream's floodplains weren't adequately captured. Therefore, 3xbankfull adequately characterizes the landscape's floodplains as a whole. See Figure 5 for an example of floodplain delineation along Swamp Creek.

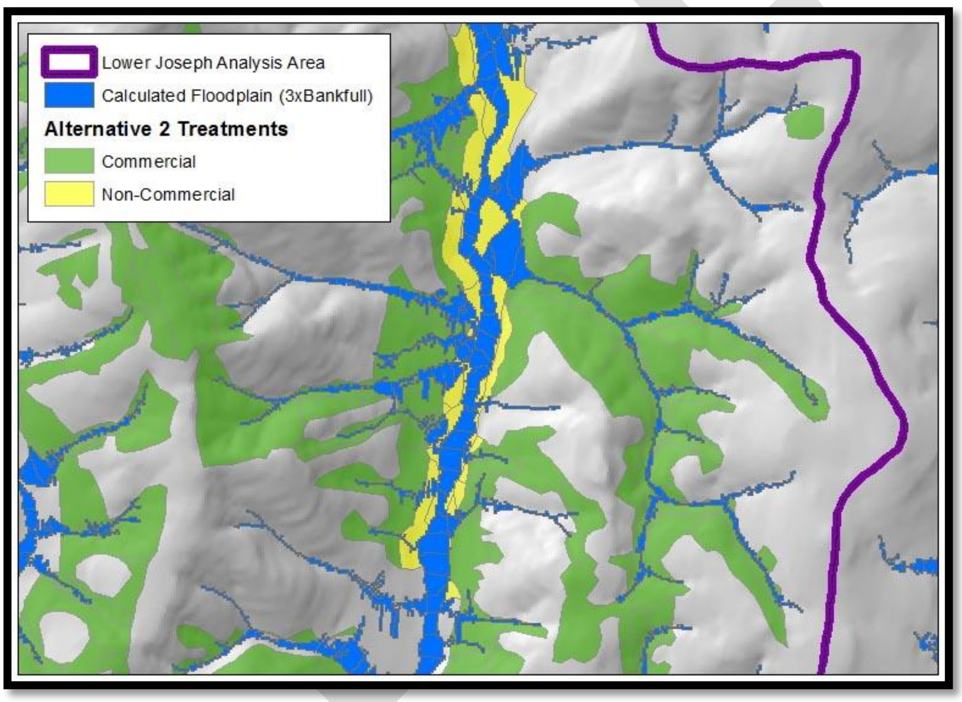

Figure 5: Example of floodplain calculation along Swamp Creek

Conclusion

The proposed treatments in both action alternatives will not have any adverse effect on the current function of any of the floodplains in the analysis area. 58 acres of vegetation management is proposed in Swamp Creek's historic floodplain under Alternative 2. Swamp Creek's floodplain is already very impaired due to channel incision and general loss of channel structure and complexity. The activities proposed are designed to restore forest structure, composition and pattern based on historic information. Restoring the other aspects of Swamp Creek's floodplain were not evaluated in this analysis.

Landslide Potential Analysis

Model Used:

Generic Erosion Prediction Model (Burnett and Miller, 2007), NETMAP Interface

Input Parameters:

To predict the potential for shallow landslides and gully erosion we used a topographic index called "Generic Erosion Potential" (GEP) that is based on slope gradient and convergence developed by Burnett and Miller, 2007. All calculations are based on a 10 meter Digital Elevation Model. The GEP model does not take into account geology, soils, vegetative cover, hydrography or any other local information. It is only analysis of bare earth potential.

Results/Conclusion

This analysis indicated areas that were more susceptible to mass wasting in the context of potential delivery to channels. The results were not unexpected with areas at slope confluences and steep areas adjacent to channels showing the highest potential (Figure 6). This model predicts the source of most of the sediment and wood that could be delivered to channels. Sediment and wood delivery to channels are very important hydrologic functions but in this analysis we want to minimize sediment delivery to channels. This analysis helped inform treatment locations and potential temporary road locations. The information derived from the GEP analysis was augmented with field observations and site specific vegetation and soils data. The Oregon Department of Geology and Mineral Industries indicate no historic records of major landslides in the analysis area as of August, 2014. Local records and field observations indicate smaller mass wasting events that are most likely associated with high flow events such as the flood event of 1996-97.

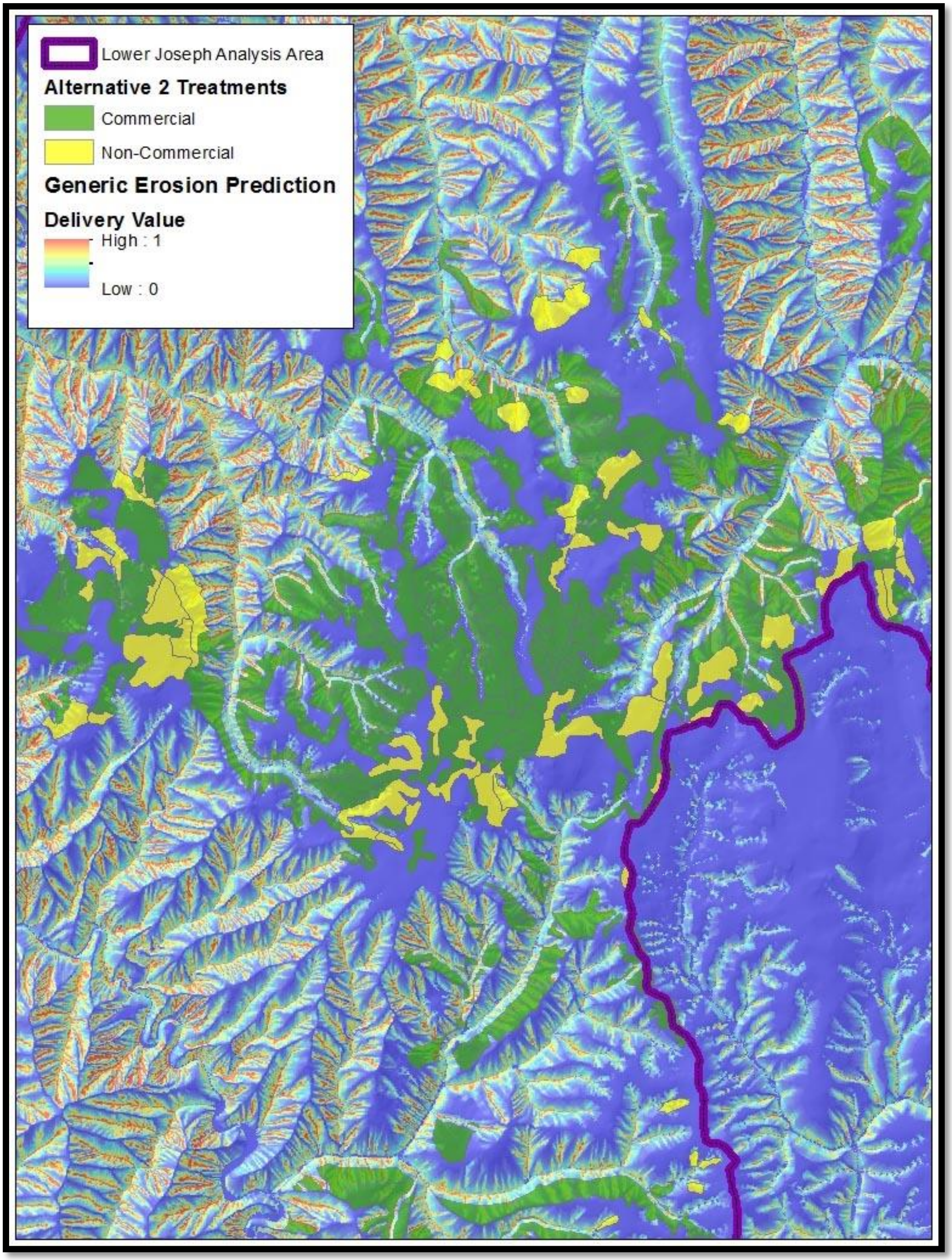

Figure 6: Example of GEP delivery which displays the likelihood of sediment and wood delivery by shallow landslides and debris flows.